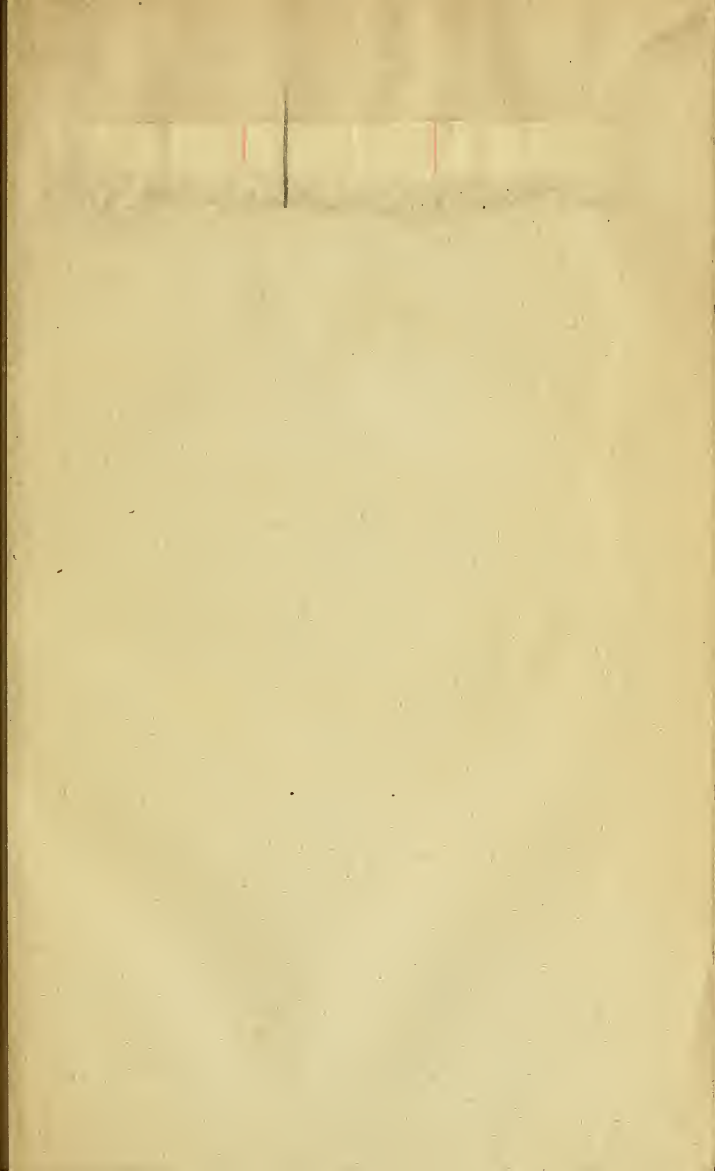





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1859.

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A MANUAL OF ORTHOPRAXY;

OR,

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ORTHOPRAXY, WITH ESPECIAL REFERENCE TO SOME
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OF HUMAN DEFORMITIES AND DEFECTS.

Being a paper read by Mr. Heather Bigg before the Inventors'
Institute. 1870.

CURVATURE OF THE SPINE,

AND ITS

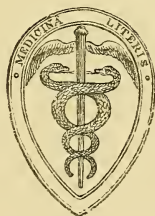
MECHANICAL TREATMENT.

1871.

THE
GENTLE TREATMENT
OF
SPINAL CURVATURE

BY
HENRY HEATHER BIGG

ASSOC. INST. C.E.



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LONDON
J. & A. CHURCHILL, NEW BURLINGTON STREET
1875

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P R E F A C E.

THE treatment of Spinal Curvature advocated in the following pages has been adopted by me for several years, but I have hitherto refrained from publishing anything relating thereto, in order that before doing so it might be submitted to the test of practical application in cases to which it is especially suited.

This I have done in a large number of instances, and carefully noted the results, from which I am able to say that the method I have termed "The Gentle Treatment of Spinal Curvature" effects in the majority of cases greater and more permanent benefit than any of the plans of procedure hitherto in use.

It will be noticed that I have not entered at any length into the characteristics of the different varieties of Spinal Curvature, or given detailed descriptions of appliances introduced in late years by myself and others for special cases of vertebral distortion.

This could not have been done without the

use of illustrations, which, together with the descriptive text, would have made a bulky volume instead of a mere *brochure*, as I intended.

Moreover, to have done so would have been to reproduce much that is contained in my "Treatise on Spinal Curvature," and in the "Manual of Orthopraxy," to which I would refer those of my readers who desire such information on Spinal Deformities as does not come within the scope of the present work.

If the remarks and suggestions to be found in the subsequent pages have the effect of promoting a more rational system of treating these troublesome distortions, my object in publishing them will have been fully accomplished.

HEATHER BIGG.

56, WIMPOLE STREET, LONDON,
June, 1875.

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THE GENTLE TREATMENT OF SPINAL CURVATURE.

CHAPTER I.

Former Treatment of Spinal Curvature—The “ Succussion ” Method—Forcible Reduction of Distorted Spine—Ambrose Paré’s and Scultetus’s Methods—Glisson’s Treatment by Suspension—Improved System of Orthopædic Practice introduced by M. Andry in the Eighteenth Century—Importance of Early Recognition of Spinal Curvature taught by M. Andry—Irremediable Deformity entirely Prevented by Proper Treatment in the Early Stages.

UP to a comparatively recent period, the surgical treatment of spinal deformities consisted in the application of mechanical force in such direction as to restore the osseous structures forming the vertebral column to their original and natural position. True, the methods of applying the power have not been constant,

varying degrees of force having been employed according to the ideas entertained by the operators as to the amount of violence that could be tolerated by the hapless patient ; but the object in all cases was the same—viz., *forcible restoration of the natural spinal axis.*

The rude—not to say, barbarous—methods of “succussion,” and of forcible extension of the spine, prevalent in the days of Hippocrates, and practised by surgeons in all countries for ages, are now happily swept away, and principles of treatment thoroughly in harmony with Nature’s laws have been adopted in order to maintain or restore the symmetry and perfection of the human frame.

It is instructive, however, to refer to this process of treatment as described by the “Father of Medicine :”—

“A ladder is to be padded with leather or linen cushions, laid across, and well secured to one another, to a somewhat greater extent, both in length and breadth, than the space which the man’s body will occupy ; he is then to be laid on the ladder upon his back, and

the feet at the ankles are to be fastened at no great distance from one another to the ladder, with some firm but soft cord; and his arms are to be fastened along his sides to his own body, and not to the ladder. When you have arranged these matters thus, you must hoist up the ladder, either to a high tower or to the gable end of a house; but the place where you make the succussion should be firm, and those who perform the extension should be well instructed, so that they may let go their hold equally to the same extent, and suddenly, and that the ladder may neither tumble to the ground on either side, nor they themselves fall forward. But if the ladder be let go from a tower, or the mast of a ship fastened into the ground with its cordage, it will be still better, so that the ropes run upon a pulley or axletree. But it is disagreeable even to enlarge upon these matters, and yet by the contrivances now described, the proper succussion may be made." It should be stated that Hippocrates did not himself advise this mode of treatment, for he remarked that he "was

ashamed to treat all such cases in this way, because such modes of procedure are generally practised by charlatans," but believing that spinal curvature was nothing more than partial dislocation of the vertebræ which might be reduced by counter-extension and direct force, he strongly advocated the plan of placing a patient in the prone position and then forcibly extending the spine by the aid of powerful assistants pulling in opposite directions at bandages wrapped around the hips and arms. At the same time pressure was to be applied to the distorted surface by means of a wooden lever.

Were a surgeon of the present day to recommend a "humpbacked" patient to be bound to a table face downwards, and extension and counter-extension applied to the upper and lower extremities, whilst force was being directed against the hump itself either by the operator standing on the curved spine and pressing it into position with the whole weight of his body, or by means of a weight and lever, he would be considered little better than a mad-man. Yet such was the treatment adopted

and energetically executed with much mechanical ingenuity not only by Hippocrates, but by many generations of surgeons.

A considerable amount of space might be occupied by making reference to the plans proposed for the ameliorative treatment of spinal curvature during the earlier period of surgical history, but for the practical purpose of this work it is unnecessary, and a few only of the most striking will be mentioned.

In the sixteenth century, Ambrose Paré, a French surgeon, devoted much attention to the treatment of "crook-back," and exhibited no little skill in devising mechanical appliances for its relief. Although rude in construction and cumbrous to the patient, they were a great improvement on the treatment by extension and restoration of the parts by sheer force. Unfortunately, succeeding practitioners did not take up Paré's ideas and improve his appliances, as might have been expected, and for nearly three centuries little or no improvement took place in the mode of treating spinal deformities.

In 1656 Scultetus certainly devised what he

thought a new apparatus for treating spinal distortions by means of forcible extension and pressure on the deformed portion of the spine by means of a lever, but as the principle was simply a modification of that practised in the days of Hippocrates, his plan can scarcely be said to have advanced the scientific treatment of spinal lesions. The same remark applies to the plan described by Glisson in 1651 for extending the spinal column by suspending the patient in mid-air, and hanging weights to the feet. This arrangement, however, had the merit of being less painful, and hence less barbarous in its application. Glisson's plan was said to be particularly applicable to the spinal deformities of children, and he directed that the little patient should be "cunningly suspended" by means of "Swathing Bands first crossing the Breast and coming under the Arm-pits, then about the Head and under the Chin, and receiving the hands by two handles, so that it is a pleasure to see the Child hanging pendulous in the air, and moved to and fro by the Spectators. Some," he adds, "that the parts

may the more be stretched, hang Leaded Shoes upon the feet, and fasten weights to the Body, that the parts may the more easily be extended to an equal length." He also described a whale-bone corset so fitted to the body of the patient as to keep the backbone upright, to repress the sticking out of the bones, and to defend the crookedness of them from further compression.

It is scarcely necessary to say that the "suspension" method was never very popular, for however pleasurable the sight of a deformed child suspended in mid-air may have been to the beholder, the position was anything but a happy one to the wretched little sufferer. The results were, moreover, far from satisfactory, for although the theory of extension of the spine by suspension might be plausible enough, in practice it was found that its continuance was attended by such grave constitutional disturbance that the remedy proved to be even worse than the disease.

No real advance in the treatment of spinal curvature was made until about the middle of

the eighteenth century, when M. Andry published his "System of Orthopædy," which did much to raise the treatment of spinal and other deformities from the lowest depths of empiricism to the position of a science.

The chief merit of his work consisted in the recognition of the importance of attending to the correction of any deviation from the normal symmetry of the body in early childhood, and thus preventing permanent deflection from the strictly erect position. Hitherto the early diagnosis and prevention of spinal curvature had been neglected, the attention of the surgeon having been considered necessary only when the deviation from the normal form had become so aggravated as to cause serious deformity, and more or less disability to attend to the usual avocations of life.

It is impossible to over-estimate the value of M. Andry's teachings. Their application has been the means of preventing large numbers of human beings from dragging out a miserable existence as hopelessly deformed invalids. Unfortunately, although much has been done by

physicians and surgeons since Andry's time to disseminate the views which he enunciated, and as a consequence bad cases of distorted spine are now comparatively rare, still, cases of almost hopeless distortion do come under notice far too frequently, and it is to be feared that in the majority of instances the deformity is the result of gross neglect on the part of those who had the custody of the patients in early childhood.

It is, therefore, of the highest importance that parents and those who are responsible for the care and guardianship of the young, should know that modern science and research have indisputably proved that it is now no longer necessary for a case of spinal curvature—accidents excepted—to lapse into such a condition as to give rise to irremediable deformity, or to cause impediment to free and graceful movement.

CHAPTER II.

M. Andry's Views neglected by Later Practitioners—M. le Vacher's Apparatus for Correcting Spinal Deformities—M. le Vacher's System Practised in England by Mr. Chessher—Le Vacher's and Chessher's "Gibbeting" Treatment condemned by Abernethy—Professor Schmidt's Apparatus—Violent Measures Practised by Dr. Harrisson and others early in the Present Century—Benjamin Bell's Views on Harsh Treatment—Sheldrake's Modified Treatment—Light Apparatus Introduced by the Author's Father—Forcible Lateral Compression Adopted by recent Orthopædic Practitioners—Mischievous Results of the Application of Force—Fallacy of this Mode of Procedure—Complicated and Irksome Apparatus, and Constant Supervision seldom necessary in Treating Spinal Curvature.

It would not have been unreasonable to expect that the effect of the promulgation of M. Andry's views as expressed in his "System of Orthopædy," to which reference was made in the last chapter, would have been to inaugurate a new era in the treatment of spinal deformities by substituting that which is scientific

and humane for that which is rude and barbarous. Such, however, was not the case, for, as we shall show hereafter, some of the later orthopædic practitioners clung to, and practised, modes of treatment which, in point of severity, would have delighted the hearts of the most energetic among the ancients. At the same time it must be admitted that the science of Orthopraxy* has been a progressive one, and that the general tendency of the last hundred years has been to milder measures of treatment.

In 1768, a few years after the publication of M. Andry's work, M. le Vacher described an apparatus which he had invented for supporting the head and correcting curvature of the spine by means of *gradual* extension of the whole spinal column. The apparatus consisted of a strong, well-fitting corset, supporting at the back a stout perpendicular iron rod, from the upper extremity of which another piece of metal was attached, which arched over the head

* ὀρθός, straight; πρᾶσσειν, to make.

and nearly touched the forehead. From this piece of arched metal, a steel bow, with straps, was attached, which, when adjusted, held the head erect, the extension power being increased or reduced by simply elevating or lowering the perpendicular rod by means of a ratchet and spring.

Le Vacher's system of treatment was introduced into this country by a surgeon named Reid, and was adopted, with slight modifications, by several other medical men who paid special attention to spinal deformities, among them being Mr. Chessher, of Hinckley, in Leicestershire, who obtained a great reputation for a time, and to whom flocked the deformed, of all classes, from all parts of England, in anticipation of a speedy cure. A young lady, who was a patient of Chessher's for twenty-two years (!) thus describes the treatment to which she was subjected:—"At sixteen, when I enjoyed good bodily health, I first became Mr. Chessher's patient, and commenced to wear his steel collar, which conveyed the weight of the head upon the hips, and acted with

pressure below the loins by means of various steel plates attached to the lower division of the collar. I continued to recline, every day wearing the steel apparatus ; and, in the morning, during the whole time of its being fitted to the body, I remained suspended in a neck-swing, which is merely a tackle and pulley fixed to the ceiling of the room ; the pulley is hooked to the head-piece of the collar, and the whole person raised so that the toes only touch the ground. Sometimes I used the reclining bed, which combines extension with the recumbent position. It consists of two boards, the uppermost of which is made to slide with rollers upon the lower. The patient is slung by the head, fixed to the top of the under board, and lying on her back on the sliding one, she allows it to run down by means of a cord held in the hand." After twenty-two years of Mr. Chessher's treatment, this patient's spine is said to have *decreased* in length fully six inches.*

Abernethy, who advocated rest in the re-

* Vide Dr. Harrisson on Spinal Diseases, p. 78 (1827).

cumbent position, thus refers to Le Vacher's system in his clinical lectures originally published in the *Lancet*:—"But people will ask me, Cannot you do anything more, sir? and I must say, I don't know that you can, unless you choose to be 'gibbeted.' This is sometimes done; it is a fashionable way of going to work, and is what I call gibbeting. This was first proposed by Mr. Vacher, and the plan is taking the weight of the head from the pillar that supports it. A most horrible annoyance it is to the patient. Oh, the pressure against the chin and lower part of the jaw is dreadful! it produces a thickening and ulceration of the ligaments when it is carried on, as, according to the principle, it ought to be. Now, there is a Mr. Chessher, of Hinckley, in Leicestershire, who, perhaps, understands the principles upon which these machines should be constructed better than anybody else; yet I have seen patients who have been there, and certainly no such good has been done to them as I should boast of. But he certainly does support the principle, and that principle does support the weight of the body, but greatly to

the annoyance of the patient, and producing the effects I have been describing, occasioning abscesses and deformities and thickenings, and so on ; and the effect, too, of taking the weight off from the proper place is, that by using their machines for years, which they have to do, they cannot afterwards do without them ; and, therefore, if they lay them aside, they have to lie down, till they have the power of the muscles, until they can properly support their weight. But I cannot say I like his system at all, therefore I do not give my mind to it, but I advise all my patients to avoid all causes which might affect the original curvatures, to take off the weight by lying down, and so on, but the child should not lie down in any constrained attitude."

A great advance on Le Vacher's invention was achieved by Professor Schmidt, of Marburg, who, in 1794, constructed an apparatus adapted to support the whole weight of the upper part of the trunk. This apparatus consisted of a metal band to encircle the body a little below the upper border of the hip-bones but taking its bearing from their crests, and supporting a metal rod on either side of the body,

which terminated in crutch-handles at the arm-pits. These rods were steadied at the upper extremity by connecting bands and a metal plate passing across the shoulders. This instrument is worthy of notice, as the principle of its construction has been retained in all appliances that have since been devised for the treatment of similar lesions, although, it is scarcely necessary to say, numerous improvements have been effected to make spinal supports more efficient and less cumbrous.

Early in the present century Dr. Edward Harrisson and one or two others who devoted special attention to Spinal Curvature advocated and practised the ancient treatment by violent extension, suspension of the body by pulleys, and severe pressure on the protruding part of the spine; but their practices failed to find much support, and since their time violent measures have been confined to a limited circle of practitioners. In his "System of Surgery," published in 1801, Benjamin Bell refers to the treatment of spinal curvature as practised at that time as follows:—"Various

machines have been invented for the removal of distortions of the spine by pressure. All of these, however, do harm and ought not to be used. It must at once appear to any one acquainted with the anatomy of these parts, and with the nature of this disease, that the displaced bone is never to be forcibly pushed into its situation; and if this cannot be done it is obvious that no advantage is to be derived from the practice, while it is evident that much harm may ensue from it."

A contemporary of Dr. Harrisson's named Sheldrake—a man of very sound ideas on deformities generally—pointed out the error of too great weight in the construction of spinal apparatus and the importance of so adapting them to the body as to interfere in the least degree with locomotion and muscular movements, but at the same time he practised suspension and forcible measures, although in a modified degree.*

Probably the first break between the rigid

* "Animal Mechanics," by T. Sheldrake (1832).

mechanism of the past and the lighter and more pleasant forms of the present plans of treatment, may in strict right be ascribed to my father; who, as is well known, devoted thirty years of his life to the application of mechanism calculated to correct bodily distortions. Among his plans of overcoming spinal curvature was the use of an instrument having a light pelvic band with two arches of steel resting on the hips, and a padded spring running along the line of the vertebral column, removing the weight of the head and shoulders by means of rectangular arm supports.

Sir Astley Cooper recognised the great value of this piece of mechanism, relieving as it did, the chest from all constriction and pressure—thus offering no impediment to free respiratory movements, as in other apparatus, and adopted it, aided by my father, in many thousands of cases.

The apparatus was a modification of that previously planned by Sheldrake, but from its constructive merit, combining simplicity of adjustment with lightness of make, it

really heralded the approach of the gentler method of treating spinal deformities now followed by the advanced school of orthopædic mechanicians.

It contained, however, only the germ of the right principle, and being deficient of the power of changing the position of the pelvic base on which it took its bearing, it acted in severe cases more as a palliative than as a curative agent.

Hence, in severe cases of lateral curvature of the spine, orthopædic practitioners even up to a very recent period were wont to resort to forcible lateral compression, which, in their hands, led to the use of mechanism so powerful and heavy as to create astonishment as to how on earth the patients endured its application. The “Spinal Supports”—as these apparatus were incorrectly called—formed on the principle of lateral force, consisted of heavy steel rods having two or more powerful rack and pinion screws acting upon steel plates, which were gradually screwed tightly against the body. The fallacy of the principle and the mischievous character of the apparatus are readily seen, if

one would reflect for a moment on the impossibility of continuing constant compression of the body, or rather carrying it beyond certain limits, without causing injurious flattening of the osseous structures, whilst abrasion of skin was by no means an infrequent consequence of the process. In order to avoid—if possible—these evils, it became obligatory to keep the appliance and the patient under incessant supervision, frequently, indeed almost always, when first adopted, necessitating the patient being seen several times a week, that the instrument—which ought to rank among those of torture—might be regulated to the power of endurance displayed by the unfortunate wearer.

Were there any good in constantly winding up the screws of the mechanism, restoration of the deformed spine should have been most speedy, whereas it took, even in favourable cases, several years to accomplish this desirable result. The explanation of this is, that the screwing up of one day was of necessity unscrewed a few days after in order to free the patient from unendurable pressure, hence, a

kind of fast and loose process became established, to the personal discomfort and loss of time to the patient, whatever may have been the effect to the practitioner.

It is only charitable to suppose, that those who adopted this system of treatment believed it to be the best within their reach; but it is impossible to conceive anything more censurable when pursued at such cost as is usually associated with constant attention; and the marvel is that it should not have long since been discarded in favour of a more gentle and natural method. The time cannot be far distant when any mechanical device, which shall need for its success more than ordinary care and watchfulness, will be viewed with the utmost distrust by all members of the medical profession, who well know that spinal curvature, even if of slight degree and under the most favourable conditions, requires *gradual* and not *sudden* force to produce anything like a permanent or satisfactory change of form.

Few cases, excepting those in which osseous disease is present, can ever need more atten-

tion than readjustment of the "set," or constructive shape of the spinal apparatus once a month; whilst in the majority of instances readjustment once in three months amply suffices. There are, of course, cases where the age of the patient, or unusual ligamentous rigidity, necessitates the adoption of an appliance in which the rack and pinion principle is employed for support; but even in these a constant winding up of the mechanism is unnecessary.

CHAPTER III.

Treatment by Elastic Traction as practised by Mr. Barwell—Similar Method Adopted by Dr. Prince of America—Elastic Traction in use by the Author before either Mr. Barwell's or Dr. Prince's plans were published—The Recumbent Treatment—Its Disadvantages—Treatment by Gymnastic Exercises—General Remarks on the Merits of Modern Modes of Treatment.

AMONG English surgeons who have adopted milder forms of treatment due prominence must be given to Mr. Barwell, for having sought to place the mechanical reduction of vertebral deflections on a more scientific basis than that hitherto adopted in this country. He advocated the use of elastic traction brought to bear upon the spine through the medium of vulcanized india-rubber bands attached to a shoulder-loop, dorsal-pad and hip-band. The first band surrounded the shoulder corresponding with the dorsal concavity; the second rested against the enlarged side, or dorsal con-

vexity, whilst the third embraced the opposite hip and thigh. When thus arranged a triangular force is obtained, having for its object a re-disposition of the vertebral equilibrium, and causing the muscles themselves to bear an important part in the eventual restoration of the spinal column to its normal position.

The theory enunciated by Mr. Barwell is excellent, but when practically tested is found not to possess the mechanical merit its promulgator imagined. This I have shown by drawing in a preceding work,* but I may briefly refer to it here. The triangular appliance he proposed has its apex resting upon the convexities of the ribs of the more prominent side and the extremities of the base to the depressed shoulder and the hip of the opposite side, its intention being to compel the body to erect itself by an alteration of balance and a consequent unfolding of the spinal curves. This, doubtless, would be the

* "Orthopraxy" (second edition, 1869). J. and A. Churchill, New Burlington Street.

result were the fixed points established in theory found to exist in practice. An opposite condition, however, arises immediately elastic pressure is brought to bear upon the spine; for the imaginary fixed points being really moveable, the elastic bands, instead of expanding and consequently diminishing the vertebral curves, add to the depression of the shoulder, and the deformity becomes increased rather than diminished. This objection is overcome by the addition of a steel crutch along the base of the triangle; but this formed no part of the original idea, having been since made by myself. The plan, however, was undoubtedly a move in the right direction, tending as it did to a more rational system of treatment than the exercise of violent compression previously, and in a large number of instances still, practised.

An American physician, Dr. Prince, of Jacksonville, Illinois, has published a plan of treatment similar to Mr. Barwell's, and claims priority of invention; but, in justice to myself, it should be stated that before either of the

above gentlemen had broached the idea of acting upon spinal curvature by the tractive influence of india-rubber bands, I had applied the principle in three distinct forms of spinal appliances, to give effect to this novel arrangement. In my plan, however, the elastic force acted upon the body through the medium of *fixed* mechanical centres, established by means of a light metallic frame ; whilst in theirs the body itself gave, or rather was supposed to give, a *point d'appui* for the force employed—a very wide distinction, as those who in treating spinal deformities have sought, sometimes in vain, for a steady bearing-point from whence to obtain their power, will readily distinguish.

In describing the modern treatment of spinal distortions, reference should be made to two other modes of treatment, which have found many supporters—viz., recumbency and gymnastics. The merit of introducing rest in the recumbent position, as a systematic mode of treating spinal deformities, is due to Dr. Darwin, who published his views in 1796. This talented physician invented a chair for carrying

out his plan of treatment, to which were attached a head-swing and crutches, to act in the same manner as the corresponding pieces of mechanism in Le Vacher's and Schmidt's instruments, which have been already described. Spinal couches have been largely used, not only in this country but on the Continent and in America, and in cases where the patients have been able to maintain the recumbent or the prone position a sufficiently long period, their use has been attended with a fair amount of benefit.

A great disadvantage connected with this mode of treatment is, that the constrained position and confinement within doors affect the patient's general health to a greater or less degree, and often so seriously as to necessitate the discontinuance of the treatment. Not only does the general health suffer, but the muscles become weakened and atrophied through disuse. There are, however, some cases, notably those in which spinal disease is in an active stage, which imperatively demand rest as the prime agent among curative measures. Care,

however, should be taken to adopt a less irksome mode of treatment as soon as the condition of the spine renders such a course safe.

Gymnastic exercises have been extensively practised on the Continent for the purpose of correcting deformities during the last thirty-five years, and we are largely indebted to foreign practitioners for the accurate knowledge we now possess as to what they can and what they cannot effect. In slight cases of deformity gymnastics are alone sufficient for their relief, whilst the judicious and regular practice of suitable exercises should take the first place among measures designed to prevent the development of spinal deformities. For full details respecting the exercises necessary to particular cases, the reader is referred to my "Manual of Orthopraxy."

From the preceding sketch it will be seen that hitherto there have been three accepted methods of treating spinal curvature, viz. :

Mechanical appliances.

Recumbency.

Gymnastics.

Each of these has its respective merits, but it is in a combination of the whole that the solution of those difficulties which are familiar to all who have made the correction of vertebral distortions their study and pursuit, is to be found. Whilst accrediting to rest due merit as a means of removing from the yielding column its tendency to increased displacement when called upon to support the body in the erect position, it must not be overlooked that there are other causes beyond mere vertical weight which lead to the production of vertebral deformity. Variety in osseous structure, difference in ligamentous tension, absence of muscular equilibrium and other causes, which will be more particularly referred to in a subsequent chapter, will invariably eventuate in the formation of a spinal curve for the removal of which mere reclination is utterly inadequate.

It is equally clear that a dependence on exercises *alone* is to be condemned, for how is it possible that the strengthening of the muscles acting upon the spine can do otherwise than maintain by their tension any curvature

incidental to that change of osseous structure, so frequently found associated with ordinary cases of spinal distortion?

Objection can likewise be urged against the adoption of rigid mechanism, for the application of constant force or pressure is far more likely to produce alteration in the surfaces to which it is applied than create satisfactory change in the vertebral curves themselves.

There are, however, notwithstanding these objections, many advantages to be gained from rest, gymnastic exercises, and mechanical support when judiciously employed, such as recruited strength, increased muscular vigour, and the removal of the curve-producing force arising from ligamentous tension. A system of treatment which may be expected to confer all the advantages of the other methods is at once novel and worthy of investigation. This may be briefly stated as consisting in the adoption of a spring poise which gives rest to the spine, action to the weakened muscles, and corrective influence through the medium of gravital force to the vertebral curves. The

mechanical details of the method will be explained in subsequent pages, but before doing so it may be as well to say a few words on the nature, varieties, and causes of spinal deformities.

CHAPTER IV.

Definition of Spinal Curvature—Its General Characteristics—Muscular and Ligamentous Relaxation frequently associated with Spinal Curvature in the young—The use of heavy apparatus irrational in such cases—Distinguishing Features of the different varieties of Spinal Curvature—Causes of Spinal Curvature—Commencing deformity often overlooked in Girls—Indications of treatment in cases associated with General Debility—Hereditary Transmission as a cause of Spinal Curvature—Difficulties encountered in treating cases of Congenital Origin—Osseous change in the Vertebrae, an insuperable bar to complete Cure—Ameliorative results obtained in such cases by the “gentle” treatment.

By “spinal curvature” is meant a state of the vertebral column in which a departure from the median line established by Nature has become either variable or permanent,* and this

* The terms “variable” and “permanent” are used to distinguish between a deflection, which when accidentally assumed can be readily corrected by an exercise of voluntary muscular effort, and one in which the spine retains its altered position, and cannot be restored to its normal place without the aid of external force.

may occur in an anterior direction, as in lordosis; posterior, as in cyphosis; laterally as in scoliosis, and horizontally as in rotatory displacement.

It may be premised that all deflections of the vertebral column, whether variable or permanent, are accompanied by a disturbance of the relations which exist between the ordinary mechanical forces of the body and their maintenance of due equilibrium. In other words, as soon as the spine has undergone any displacement from its symmetrical condition, various disturbing elements are at once called into operation, the most marked of which is an inability on the part of the patient to restore the vertebral column to its normal state, unless by such an expenditure of muscular power as can be maintained but for a very brief period, or by having recourse to extraneous assistance.

This characteristic indicates the first stage of spinal curvature, and although it must be admitted that a feeling of debility may be induced from constitutional or other causes

simulating in a marked degree the condition just alluded to, yet careful examination will readily determine what is due to general muscular weakness, and what is the result of impaired symmetry of structure. In the former case restoration of the general health speedily removes all trace of spinal curvature, whilst in the latter it confirms any previously formed suspicion, by demonstrating with certainty a departure from the natural form.

Any one who has taken the pains to observe the awkward positions children permit their bodies to assume when over-fatigued by undue exercise, or incapable of sustaining their figure erect from weakness engendered by rapidity of growth, must have noticed for how brief a period any correction of form lasted, when, in obedience to their request, an attempt has been made to sit more upright. When this observation is followed by careful professional examination, it will almost invariably be found that the fault attributed to the wilfulness of the patient is really due, either to ligamentous relaxation, or muscular weakness, and, it may be, to both,

thus clearly evidencing an existence of the primary germ of what time and neglect will assuredly develop into pronounced spinal curvature. Of course it is not intended to advance that muscular and ligamentous weakness are the sole features of spinal curvature, for osseous disease and congenital variations in the shape of the articulating surfaces take a very important position among its producing causes, but these will be discussed further on ; for the present it is only necessary to bear in mind the proposition just stated — namely, that whenever the spine, otherwise well-formed, manifests either temporary or permanent deflection, an interference with muscular equilibrium has taken place. To neutralize this disturbing force ought to be the primary object of treatment, and should be accomplished with as little discomfort and interference with the ordinary avocations of the patient as possible.

It is irrational, to say the least, to make a young and growing girl, the subject of spinal curvature, bear the discomfort of a heavy apparatus when she can hardly sustain the

weight of her own body, whilst it is questionable whether the employment of such means tends to diminish the deformity for which it is called into requisition. Yet, notwithstanding the palpable objections to overburdening an already enfeebled frame with cumbrous apparatus, its practical adoption has for a considerable period been the sheet anchor of modern orthopædists, who, in conjunction with their mechanics, have vied with each other in proposing complicated and ingenious applications of the one general principle—namely, compelling the vertebral deflection to yield before an application of great external force, instead of re-establishing the natural equilibrium by calling into action the restorative power available through the medium of an altered base. Undoubtedly, in severe cases, where there is much ligamentous resistance, a certain amount of force has to be exercised to overcome it, but in the majority of instances of deformity of the spinal column, the use of such extreme mechanical force is never necessary. Whilst discouraging the employment of

force, it is not intended to discountenance the judicious use of *support* in cases where the deformity is due to muscular weakness, or ligamentous relaxation; indeed, in most cases the greatest comfort and permanent benefit result from the adoption of a properly adjusted spinal support. Especially is this the case in the young, for during the period of adolescence the recuperative powers are so active, and the frame so yielding to external influences, that the restoration of perfect symmetry may be hoped for even in bad cases of spinal deformity.

When a spinal curvature has become confirmed, certain general features are presented, which vary according to the direction in which the deflection has taken place. Thus, in anterior curvature, which is most common in the lumbar region, there is a deep hollow in the loins, the abdomen is very prominent, the upper part of the back is unusually rounded, and in the erect position the chin is elevated, and head thrown back. This condition has been termed *lordosis*. In posterior curvature, which is usually limited to the dorsal region,

there is arching of the back, and the head is bent forwards. This variety of spinal curvature is known as *cyphosis*.*

In lateral curvature, or *scoliosis*, there is enlargement or growing out of one shoulder, depression of the other, uplifting of the hip, and straightness of the loins.

These are the simple external distinguishing features met with in ordinary cases of spinal deformity; but there is one important condition common to all—viz., an alteration in the natural position of the spine and pelvis. In anterior curvature, the hips are tilted upwards and backwards; forwards in posterior curvature; whilst in lateral curvature there is a combination of horizontal obliquity, with an advance of the hip-axis in its relation to the median line of the body. The impor-

* This condition should not be confounded with angular or Pott's curvature in which the direction of the curve is also posterior, but the pathological condition is entirely different, being due to caries and destruction of the bodies of the vertebræ, whilst simple cyphosis is unaccompanied by osseous disease.

tance of recognising this peculiarity will be understood when, in a subsequent chapter, we enter more particularly into the question of treatment.

The full consideration of the causes of spinal curvature would occupy more space than can be devoted to it in a work of this kind; they may, however, be summarized under the following heads,* viz.:

1. Congenital or inherited imposition of form.
2. Destruction of bone tissue of the vertebræ by caries or softening.
3. Failure of balance between the tension of the vertebral column and the weight of the body, either alone or weighted with burdens.
4. Muscular traction resulting from spastic action.
5. Repeated assumption of an attitude in which the spine is curved.

* This part of the subject will be found more fully treated in the author's work on "Spinal Curvature," (Churchill, New Burlington Street, 1871.)

6. Muscular and ligamentous laxity.
7. Inequality of length in the legs, and consequent obliquity of the pelvis.
8. Falling in of one side of the chest, due to collapse of the lung after pleural effusions.

This list is indeed a formidable category, but fortunately the great majority of cases of spinal curvature owe their origin to muscular and ligamentous laxity associated with general constitutional debility, unaccompanied, however, by either osseous malformation or rigid alteration of structure.

To this class belong those instances of overgrowth and consequent ungainliness of figure which are so familiar to those who have the care and physical culture of young and growing girls. The languid bearing distinctive of this condition is generally the first noticeable sign of the existence of a latent tendency to deformity, and it by no means unfrequently happens that under a mistaken impression of its being due to indolence, strong correctives are applied in the shape of increased physical

exercise. Nothing can possibly be more harmful; for the system, already overtaxed by such ordinary exertion as is inseparable from daily occupation, is too wearied to bear more, and thus the real but unrecognised source of evil is increased instead of remedied.

A girl so dealt with, often from feelings of wounded pride makes an extreme effort to appear stronger than she really is, but this cannot be maintained for a lengthened period, and she speedily lapses into her old state. As a general rule, whenever a girl of growing age habitually assumes lounging attitudes, it may safely be predicted that on professional examination her spinal ligaments and muscles will present such indications of debility as shall account for the adoption of the objectionable postures. If, therefore, instead of mischievously calling upon Nature to increase her lessened power by voluntary effort alone, means were adopted in aid of her resources by the use of slight mechanical help, accompanied by such therapeutic treatment as may be deemed advisable by the medical attendant, a gradual

conservation of force would be secured, and the patient, previously weak and delicate, become strong and healthy.

Building up and strengthening the body without, at the same time, guarding against the production of increased vertebral deformity, can only be characterized as dealing in half-measures, which in all probability will result in a comparatively vigorous frame being still engaged in the maintenance of conflict between the already deflected spine and the muscles whose function it is to preserve equilibrium in the various parts constituting the trunk.

In such cases as those just alluded to, what is strictly needed is a power which shall supplement muscular force in such direction as it is found to be deficient. The most certain method of doing this is by the application of mechanical help, but the question arises as to what is the best way of employing this valuable agent. Up to such a recent period as only ten years ago, the first step in the way of ameliorative treatment would have been either to enjoin entire recumbency until a recuperation of

bodily strength had been gained, or to adopt a rigid piece of mechanism in the shape of a spinal instrument, so constructed as to act somewhat in the same manner as a buttress placed against a falling house.

As has been already shown, neither of these plans is strictly scientific, for one tends to debilitate the muscles by disuse, and the other creates a feeling of dependence on the part of the patient, rendering future withdrawal of the instrument a matter of serious difficulty.

It is to meet these objections that a more rational plan of treatment is proposed, to which the name of "Gentle" has been given as being suggestive of its moderate character. Thus, taking for example the conditions just proposed—namely, that of a young lady whose spine has so far deviated from the median line as to be incapable of restoration without a great expenditure of voluntary effort, the requirement demanded is stimulus to muscular action by the adoption of some adventitious force which shall be an aid to, *but not a substitute for*, natural action, the mode of accom-

plishing which will be detailed in the next chapter.

Among the causes of spinal curvature, hereditary transmission, which occupies the first place in the above list, is frequently overlooked, or if suggested, is rarely admitted by the parents or friends of the patient.

This subject is one of considerable importance, for if vertebral deformity in the parent were the unvarying cause of deflection in the offspring, all would be similarly affected. This, however, is well known not to be the case, which may probably be explained by the analogy that in a large family of children only one or two will present any peculiarity of facial form distinctive of the parents' physiognomy. Similarly, only one or two of a family of children may have spinal curvature, although the father or mother present all the recognised characteristics of the malady.

Observation demonstrates, that in both these instances the impression of form is not purely accidental, but obtains its derivative from the physical construction of the parent, for whilst

the facial lineaments are similar to the original features, the variety of spinal curvature is almost invariably in agreement with the proximate type.

This source of origin is referred to on account of the bearing it has either upon the probability of curative treatment being successful, or the amount of mechanical force which may be necessary in any given case to produce simple amelioration of form ; for where the distortion is of a congenital character, certain modifications or abnormalities of osseous structure present themselves, which create an insuperable obstacle to complete removal of the deformity.

When, therefore, any extreme rigidity of the spinal column is found to accompany slight lateral curvature, it may be taken for granted that some unusual condition of the articular surfaces of the vertebræ exists, which has in all probability congenital origin.

In all cases where the distortion is strongly marked and of long standing, an alteration in the articular facets of the vertebræ invariably

exists, due to absorption produced by that excessive pressure which results from long-continued assumption of a position necessitating vertebral deflection, and the consequent inequality of force, brought to bear upon the intervertebral articular cartilages at their external margins. When this condition exists, whatever the cause may be, it constitutes an incurable affection. Whilst, however, complete cure must not be looked for, a considerable amount of good may be effected by removing through mechanical agency the extreme inter-articular pressure, and diverting it in such a manner as to improve the position of the whole column. To accomplish this, demands, in rare and severe cases, great power on the part of the appliance adopted, but in the large number of instances "gentle" and continuous opposition will do more good to re-establish a better osseous arrangement than irksome pressure.

Thus, in cases of undoubted *congenital* origin the use of a pliant apparatus accomplishes more than one of rigid structure, but in order

to secure every possible advantage, it is better to induce the patient to use a stronger apparatus for the first few months of treatment, after which it should give place to one constructed on the "gentle" principle.

CHAPTER V.

An alteration of Hip, or Pelvic Plane, an essential feature of every variety of Spinal Curvature—The forces which operate to effect this change—Functional disturbances caused by the alteration in Hip-plane—Rectification of Hip, or Pelvic-plane the keystone of the Gentle Treatment of Spinal Curvature—The immediate beneficial results of the procedure — Description of the mechanical appliance for restoring and maintaining true Pelvic Obliquity—The rationale of its action, and mode of adjustment explained—Conclusion.

It was stated in the preceding chapter that there is one distinguishing characteristic common to all cases of spinal curvature—viz., a departure of the hips from the natural plane of antero-posterior obliquity. In the perfect anatomical position, the spinal column and pelvis have an angle of 140° , and it is to this fact that those graceful curves found in the loins and shoulders are due. When, therefore, any alteration takes place in the relative positions of the spine and the pelvis (which forms

the base of the vertebral column), these curves become increased or diminished according as the angle formed by the junction of the spine and pelvis is greater or less than is strictly normal. Thus when the pelvis assumes a more horizontal position than is natural, the lumbar curve is diminished*—and may be entirely lost—whilst the dorsal curve is increased.

To enable the spine to maintain its relation to the pelvis, large and powerful muscles are provided, which have their attachments to the pelvis and along the whole vertebral column; the vertebræ themselves being united each to each at all their articulations by strong ligaments.

When these muscles and ligaments are unimpaired by debility or disease, they compel the spine to retain its normal curves, and the pelvis its true obliquity; but should mus-

* Diminution of the loin-curve is a striking characteristic of lateral curvature, and its restoration to the normal form should be one of the first objects in mechanical treatment.

cular and ligamentous laxity be engendered through constitutional debility or any other cause, a pernicious redistribution of parts ensues. Those curves which have hitherto given tension to the spinal column, undergo change of character from the absence of true resilient power previously received from the healthy-toned muscles. Coincident with the changes in the spinal curves, there may be observed an alteration in the position of the pelvis, there being a tilting upward of its anterior surface corresponding with the loss of lumbar concavity.

This disturbance in the relation between the column and its base not only lessens the general stability in gait, and gracefulness of movement which characterizes perfection of form, but it materially interferes with the due performance of the natural functions of the heart, lungs, and abdominal organs. This may be readily proved by observing the condition of a person who exhibits the distinctive marks of ordinary lateral curvature.

On regarding the chest it will be found

depressed and contracted, whilst as a concomitant to this condition, the shoulders will be seen to have lost their natural flatness, and a general disposition of the whole of the upper part of the body to yield in a forward and lateral direction presents itself. As a consequence the area of inspiration is circumscribed, and thus the free and full expansion of the lungs is prevented, whilst the heart, being pressed upon, no longer enjoys the freedom which it requires in order to fulfil its important office of controlling the circulation of the blood. The result of this impediment to the expansion of the lungs and the supply of air being diminished, is imperfect aëration of the blood, and this, together with the obstruction to the free action of the heart, tends still further to impair the general health. In addition to the lungs and heart being prejudicially affected by this depression of the upper part of the trunk and contraction of the chest, it is found that the same condition affects secondarily the abdominal viscera, causing downward displacement. This is explained by the fact that the

action of the lungs being limited by the abnormal condition of the chest-walls, part of their expansive force is expended on the muscular and membranous partition which separates the thoracic from the abdominal viscera, and thus there is to some extent an interference with the due performance of the functions of the latter set of organs. Besides this, the pushing down of the diaphragm causes greater prominence of the abdomen, and eventually there is, in many cases, yielding of its walls. The abdominal fulness is still further increased by the tilted position of the hips, which has already been stated to be the proximate cause of the whole mischief.

This may be demonstrated by observing the change in position of the whole trunk and its contained viscera, which takes place when the hips are held backwards and upwards. Rectification of the pelvic-plane thus effected, renders the walls of the abdomen tense, whilst more space is afforded for the intestines, the diaphragm is rendered taut, the chest uplifted, and the lungs given larger space in which to

expand. The heart also, relieved from the pressure which surrounded it and impeded its action, is left to more freedom of movement. But the beneficial effect of changing the position of the pelvis as above described, does not end here; for it causes the axis of the hips to be more nearly approximated to the centre of gravity of the whole body, thus giving the lower limbs the power of being more easily thrown forward, and the whole frame obtains a bearing similar to that which is conferred by vigorous and well-regulated muscular exercises, when undertaken by a sound and healthy person free from any vertebral deformity.

It is, perhaps, scarcely necessary to observe that the improvement resulting from an altered relation between the hips and the body consequent upon the angle of the spine and pelvis being advantageously varied, is only temporary in consequence of the muscles being incapable of sustaining for any lengthened period the strain upon their already impaired powers. But although in these cases the muscles are not able to perform this task, it is perfectly

practicable to attain the desired result by mechanical art. The method of doing this is the real meaning of what I have termed THE GENTLE TRÉATMENT OF SPINAL CURVATURE, and which will now be explained, free, as far as possible, from technical terms, although these cannot be entirely dispensed with.

Bearing in mind, then, that in the cases above described the natural curves of the spine are lost, and the pelvis rendered unnaturally horizontal, the indication of mechanical treatment is presented in an indisputable manner. It consists in the restoration of true pelvic obliquity, with a reproduction of the original vertebral arcs accompanied by free muscular movement and an uplifting of the chest and its contained organs.

This is effected by the adoption of an appliance, which, while so spring-like in construction as to admit of the wearer bending the body freely or performing any amount of muscular movement, yet at the same time acts like the erector muscles of the back themselves, and, what is of the utmost importance, causes the

hips to be tilted backwards so as to restore gradually and permanently the normal angle of 140° . The mechanism of the appliance for accomplishing this is extremely simple. It consists of a pelvic spring which surrounds the hips: two vertebral springs* to simulate the spinal muscles; and two axillary springs whose office is the uplifting and expansion of the chest, and a belt of linen to give support to the abdominal walls. A pair of stays made in the style ordinarily worn by young ladies, with

* In all cases of lateral curvature there is a more or less marked rotation in a horizontal direction of the transverse processes of the vertebræ, hence the vertebral springs are so arranged as to bear upon points corresponding to the displaced processes, care being taken to leave the spinous processes perfectly free from pressure.

I am greatly indebted to Sir James Paget for a suggestion which increases the value of this arrangement—namely, the addition of two narrow pads fixed by springs which press against the transverse processes of the prominent dorsal and lumbar vertebræ. This renders the apparatus absolutely perfect in mechanical action by combining in one instrument the power of maintaining an altered pelvic base as well as correcting the rotatory displacement of the vertebræ.

one busk in front sufficiently long to rest upon the pad in front of the pelvic springs, and constructed with the lightest of bones is placed over the whole. This forms a very perfect and light spinal support, and it interferes with the set of the dress to so slight a degree that when worn no ordinary observer would form an idea, except in the presence of an improved and graceful carriage of the body, that any extraneous means have been resorted to for the correction of the distorted spine.

It must not be imagined that the simple application of an instrument constructed on the model of that above described is alone sufficient to effect that change between the pelvic base and the spine which is the prime object of the "gentle treatment." Each particular case requires some modification or variation as to the amount of resilient force that may be necessary, and the direction of its employment. To decide these points, and to secure success, a knowledge of the principle which governs the mechanical forces acting upon the spine and

pelvis is essential; in other words, one must understand how to produce such a change in the action of the vertebral muscles as shall first antagonize, and finally employ in an advantageous direction the disturbing cause.

In order that this may be accomplished effectually, much care is needed to ascertain with precision, not only the resultant of gravital force, but also what is due to ligamentous relaxation, and how much may be attributed to muscular traction.

For example, in an ordinary case of slight lateral curvature, unaccompanied by disease or osseous change of structure, it will generally be found that muscular debility is the proximate cause of distortion, and that those muscles which correspond with the dorsal and lumbar convexities are especially implicated, and lead to a redispotion of the ordinary spinal equilibrium. Hence, if the right shoulder is enlarged and the left side depressed, an exercise of force, calculated to resist further declension, is the object to be attained; and this

is achieved by so arranging the appliance that that portion of it which acts as an artificial spine may produce an opposing influence to the relaxed muscles.

The way this can be done is fortunately easy, and consists in causing the left arm-support to be slightly raised, which extends the concavity of the principal curve—namely, that in the region formed by the shoulders, whilst the springs which pass along the sides of the spine are bent so far backward as to compel the enlarged shoulder to flatten itself by the power of extension. On this latter point being achieved, a redistribution of muscular force ensues, favourable to the gradual recovery of contractile power on the part of the lengthened or relaxed muscles, with corresponding elongation of those whose tension has hitherto helped to maintain, and even increase, the curvature.

In addition to this arrangement of vertebral levers and axillary spring, the pelvic band must be tilted downwards, thus so far altering the base of support as to still further favour

the maintenance of the erect posture and the gradual extinction of the lateral curves.

On the magnitude and direction of the curves will depend the precise amount of deflection which should be given to the vertebral levers ; but when this is satisfactorily arranged, the natural movements of the body largely tend towards restoration of the spine by calling into activity that disposition towards recovery of equilibrium which is an essential characteristic of the human body.

One of the first conditions to aim at in the treatment of cases of curvature arising from muscular weakness is the production of parallelism between the horizontal axes of the shoulders and hips. This is secured by placing the axillary springs at an equal height, whilst those surrounding the pelvis are relatively horizontal. The vertebral levers are so "set" as to throw the chest open and the hips backward, which with the parallel position of the shoulders insure equilibrium of the whole spinal muscles, and eventually rectification of the abnormal curves.

It must not be overlooked that in "setting" the back levers, they should be made to represent in form the shape of the loins, hips, and shoulders, that they may the better afford support to the weakened spinal column, whilst calling into operation the power of the muscles, which especially maintain the vertebræ in their true position.

When in addition to muscular relaxation and traction, ligamentous yielding is found to exist, a still greater amount of control over the deflected spine is afforded by the attachment of pads, which spring from the vertebral levers and partially encircle the ribs, and which support the yielding spine without in the least interfering with the general resilience of the apparatus.

Should active disease of the spine be present, two lateral crutches, so adjusted as to pass from the axillary springs to those of the pelvis, form an immobile frame of the lightest possible character, which, whilst sustaining the vertebræ and relieving the spine of superincumbent weight, prevents any mischievous movement, and secures on the departure of disease, the natural curves of the spine.

As regards the adjustment of the appliances, it will be found to be extremely simple. First, the pelvic band has to be passed round the hips, next the arm springs are placed beneath the axillæ, after which, the belt which sustains the abdomen and keeps the appliance steady, must be secured by means of a buckle, and finally, the stays, already described, should be fastened over the whole apparatus.

When thus adjusted, bodily movement is not in the least interfered with; indeed, walking and general exercise can be more readily taken, and that too with less than half the fatigue which would be experienced if the instrument were not adopted.

It may, perhaps, be as well to observe that though these appliances need far less professional supervision than those of the old-fashioned structure with their complicated arrangement of racks and pinions, yet it is important that the improvement which the spine undergoes should be noted from time to time, and the opportunity taken advantage of, to effect whatever alteration of "set" in the vertebral levers may be required; but this

need only be done at comparatively long intervals.

Before concluding, it should be mentioned that the perfection which has been achieved in the construction of the best form of spinal apparatus for carrying out in the most efficient manner the "gentle treatment" of spinal curvature, is in a great measure due to Dr. Protheroe Smith. His principle of treating uterine displacements through the medium of an altered mechanical position, or relation between the pelvis and the vertebræ, as explained in his lectures delivered at the Hospital for Women, led to the invention of what is termed a "pelvic band," which constitutes the original idea of the system of treatment of spinal curvature advocated in these pages, a system, it is not too much to say, better calculated to restore vertebral deflections than any other yet devised.

It must, though, be admitted that during the last twenty years attempts have been made to correct spinal curvature by calling into operation the muscles themselves as auxiliary

agents to mechanical power; but the absence of a fixed base limited the result and confined it within a narrow area of action. Now, however, that means have been found of producing a direct effect upon the spine and pelvis through spring power applied around the loins and inferior abdominal region, there is a much more extended range of exercise for mechanical action to restore equilibrium. This is most effectively called into activity by the spring-like character of the instrument above briefly described.

In the ordinary form of apparatus, muscular resistance is an element of trouble, to overcome which much of the power of the instrument is directed, whereas with proper scientific mechanism this force becomes a factor in the eventual restoration of equilibrium, and in this way the cure is expedited, and the task of the orthopædic practitioner materially lightened.

It has been stated already that the cases most amenable to treatment are those in which the deformity is in an early stage, and it cannot be too firmly impressed on the minds of those who

have the care of youth, that the recognition of incipient deformity would in almost every instance lead to an entire removal of the threatened mischief, if appliances calculated to call into activity the muscular forces of the body, whilst freeing the vertebral column itself from overweight, were promptly adopted.

LONDON:

SAVILL, EDWARDS AND CO., PRINTERS, CHANDOS STREET,
COVENT GARDEN.



FBI Bindery,
DEC 8 1902

